Ground Truth Aftershock Locations in Tibet Using Results from InSAR

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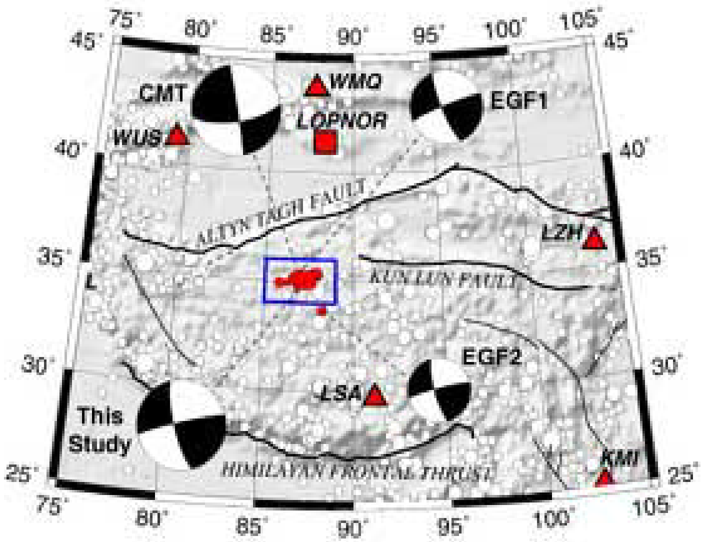
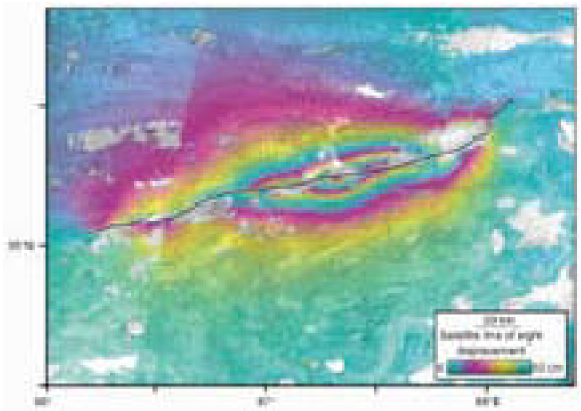
Introduction

- Aftershock relocations of the 1997 Nov. 8 (Mw = 7.5) Tibet earthquake poorly located with teleseismic data and standard techniques.
- Mainshock and secondary surface rupture (ground truth) identified from InSAR (Peltzer et al., 1999).
- No known seismic event associated with secondary rupture; goal to find event and use as ground truth.
- Largest aftershock is only mb = 5.1; must rely on regional data.
- Will add significant amount of regional data, test relocation approach, and obtain higher resolution aftershock relocations.



Seismicity, faults, and topography of the region where the Nov. 8, 1997 Tibet earthquake occurred. The USGS events from Jan. 1973 to prior to mainshock (white circles) are plotted along with PDE mainshock and aftershock locations (shaded circles). The long period surface wave solution from Velasco et al. (1999) gives a strike-slip mechanism. The earthquake occurred west of the mapped trace of the Kun Lun fault and is 750 km south of the Lop Nor Nuclear Test Site. Shaded triangles are digital stations within the region.

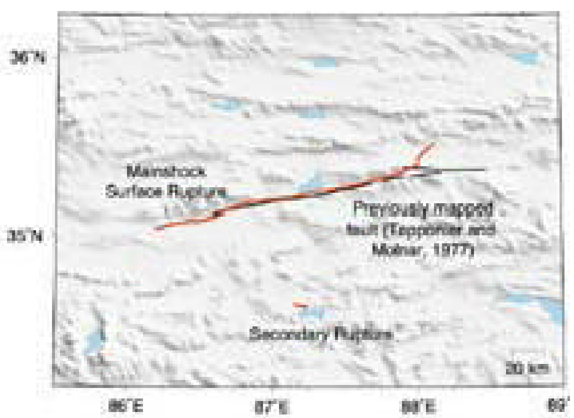
InSAR Results



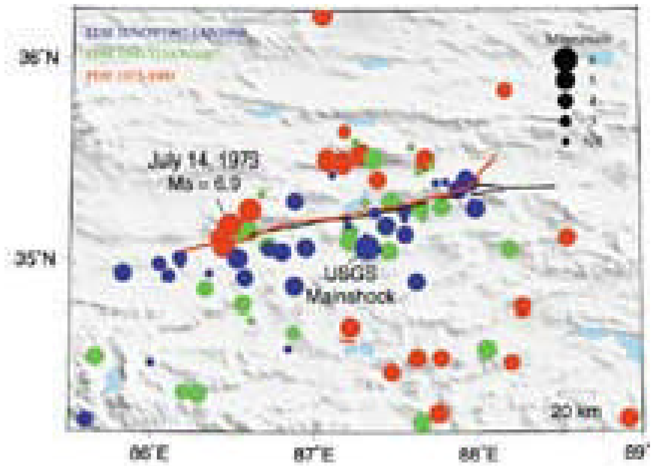
Interferometric map showing the coseismic surface displacement field. One full-color cycle (blue-red-yellow-blue) represents 50 cm of ground shift away from satellite along the radar line of sight. Uncolored areas are zones of low phase coherence that have been masked before phase unwrapping. Small color discontinuities observed at frame boundaries are due to differences of incidence angles between adjacent tracks in overlapping regions.

Figure from Peltzer, G., F. Crampe, G. King, Evidence of Nonlinear Elasticity of the Crust from the Mw=7.6 Manyi (Tibet) Earthquake, Science, 286, 272-276, 1999.

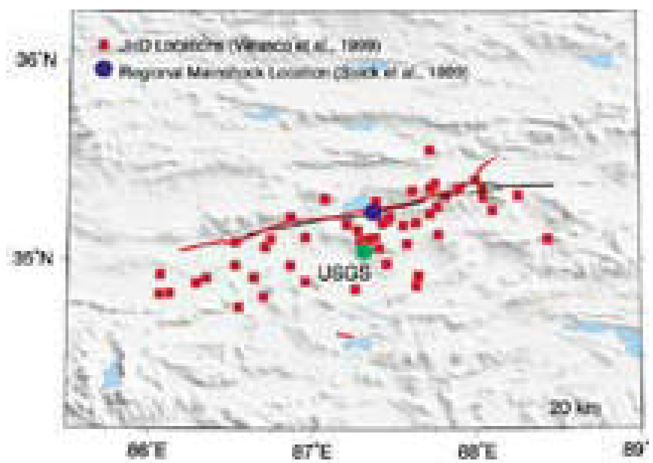
Previous Location Results



Surface ruptures determined from InSAR (Peltzer et al., 1999)
Secondary rupture possibly thrust mechanism (Peltzer et al., 1999)

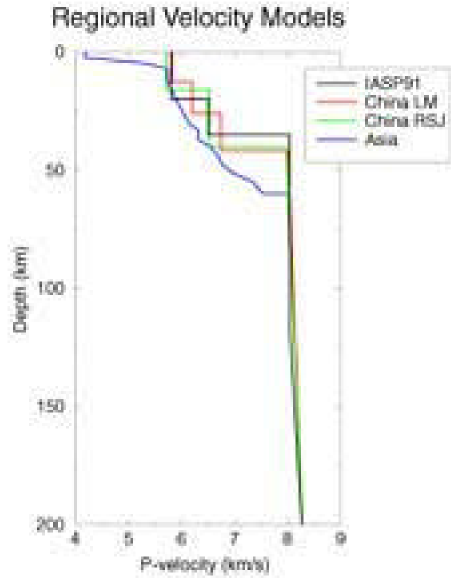


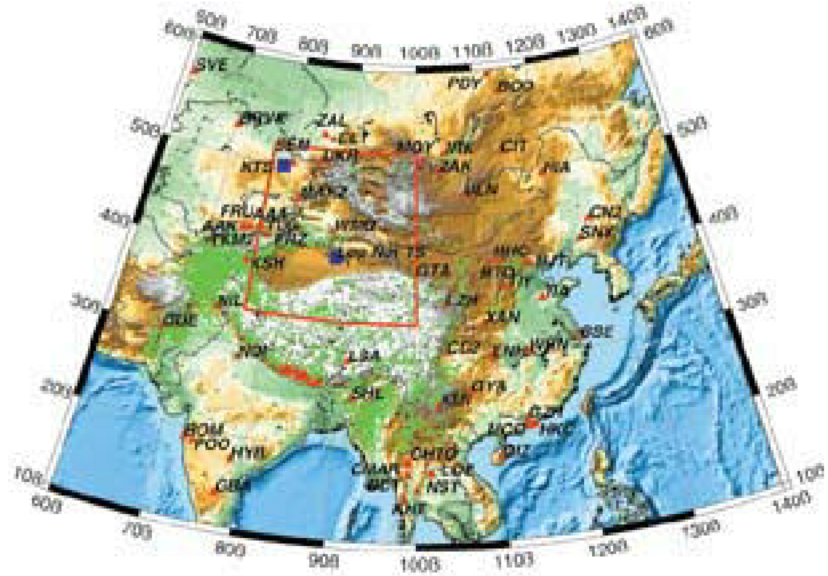
No aftershock near secondary rupture
USGS locations scattered around fault; biased south
Mainshock 20 km south of surface rupture trace



JHD locations biased south but not as scattered along fault
Regional location of mainshock falls on surface rupture trace

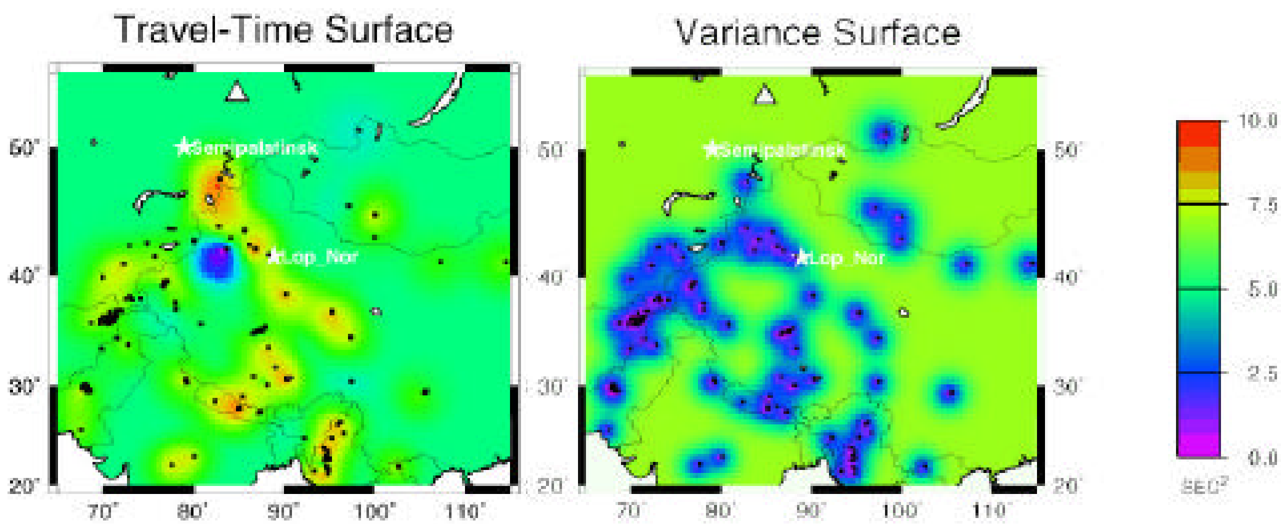
Method and Data



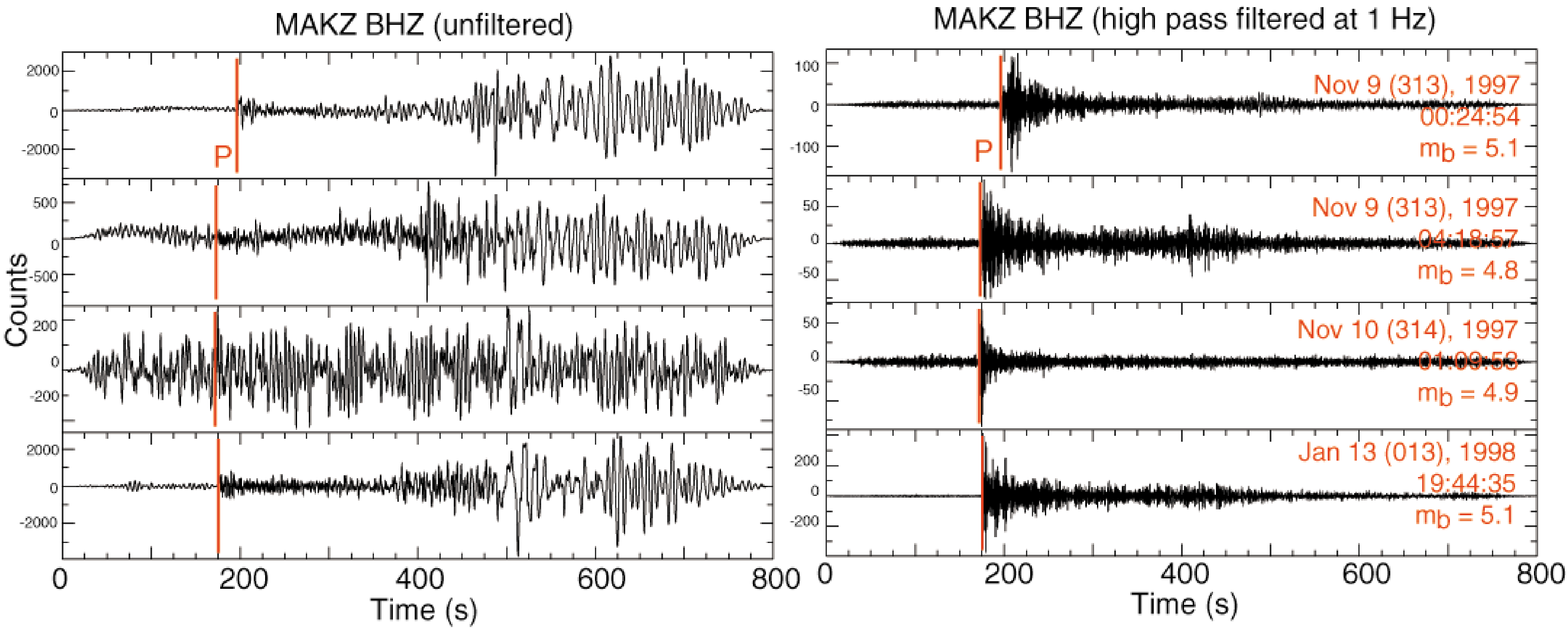


Utilize regional velocity model (China_LM) with 2-D propagation path corrections (PPCs) from Steck et al. (1999) with EvLoc location algorithm

PPCs developed from global catalog and regional waveform arrivals

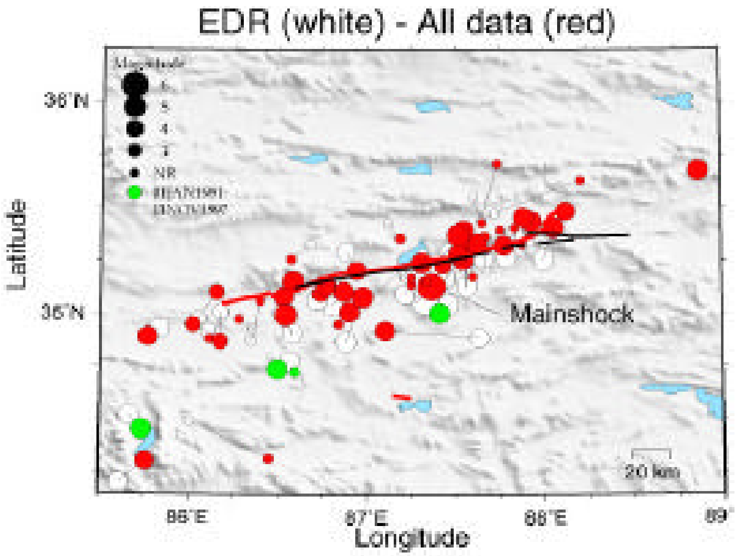


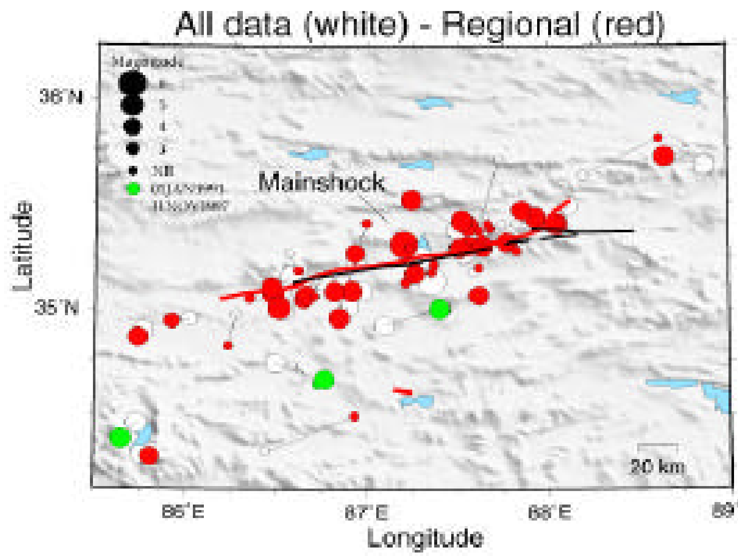
Example 2-D P-residuals kriged correction surfaces for ZAL



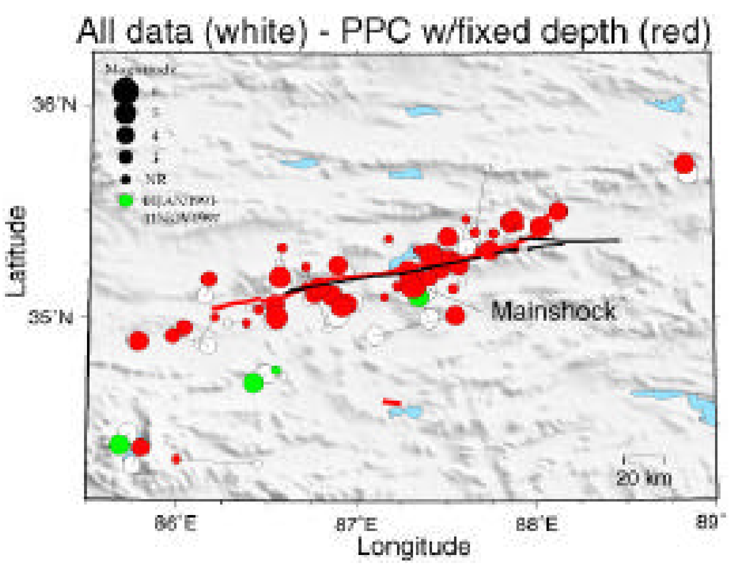
Example regional waveforms picked and used for location
Added 349 P arrivals for 61 events

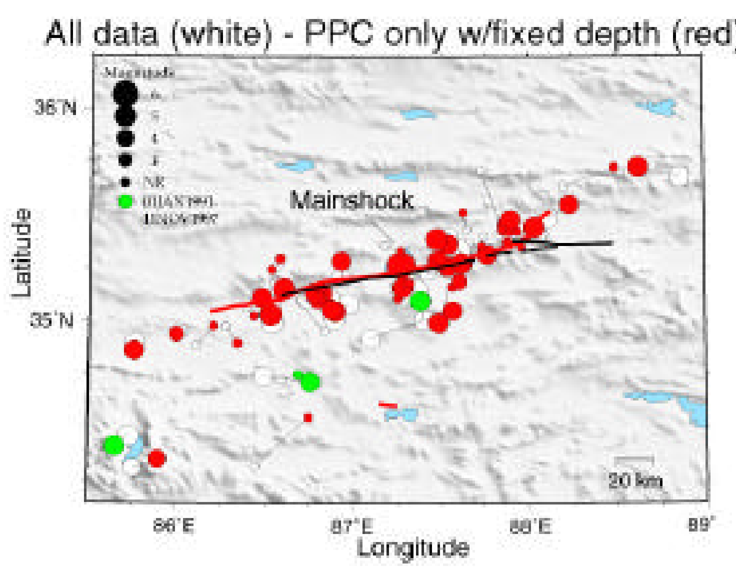
Results



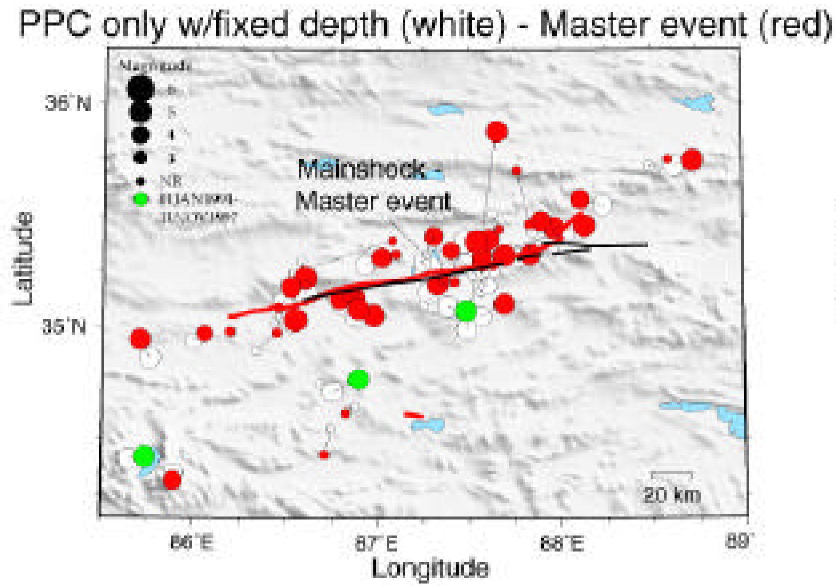


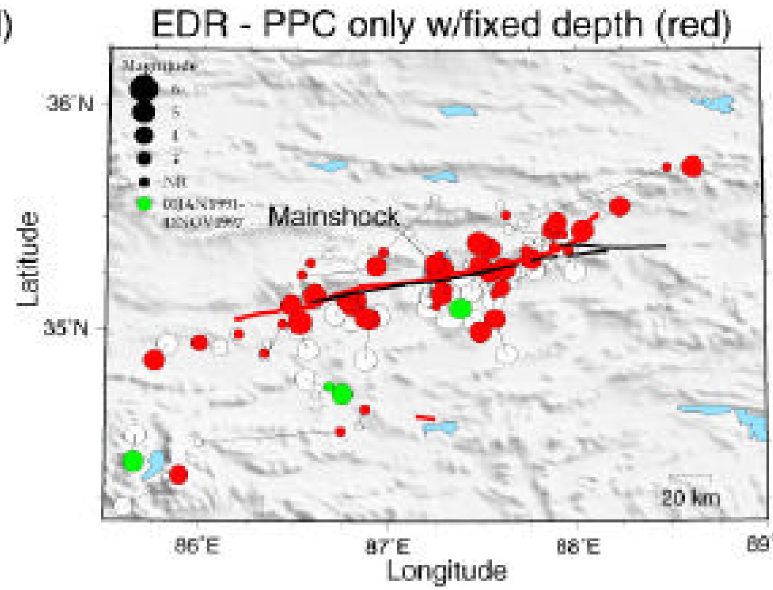
Addition of regional picks helps reduce scatter of both teleseismic and regional locations and appears to stabilize locations
Notable teleseismic and regional location biases





Using PPCs clusters events near fault with and without teleseismic data
Fixing depth helps with regional locations using PPCs (poor depth control)





Using mainshock as master event produces some changes for some smaller event locations, but no general shift
Comparison of EDR to PPC only solutions with fixed depth shows better event clustering near fault
No aftershock near secondary rupture for all solutions

Summary and Future Work

- Secondary rupture either poorly located or coseismic with mainshock
- Additional regional data helps reduce scatter for all locations
- Use of 2-D PPCs helps cluster events near fault
- Redo JHD locations with new regional data
- Use this data set for other CTBT related studies
- Perform regional source modeling for mechanism looking for thrust event (secondary rupture)

For more information, view our “Technical Documents” section at http://www.ees3.lanl.gov.